PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

Vol. 42, No. 13, pp. 341–348, 5 figs. June 24, 1981

Marine Biological Laboratory
JUL 20 1981
Woods Hole, Mass.

A REVIEW OF THE BATHYAL FISH GENUS *ANTIMORA* (MORIDAE: GADIFORMES)

By

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ABSTRACT: There are two valid species of the genus *Antimora*: *A. microlepis* Bean in the North Pacific, and *A. rostrata* (Günther) from the southeastern Pacific, Southern Ocean, and Atlantic Ocean. Junior synonyms of *A. rostrata* include: *A. australis* Barnard, *A. meadi* Pequeño, *A. rhina* Garman, and *Haloporphyrus viola* Goode and Bean. *Antimora microlepis* has 90 to 103 gill filaments on the first arch; *A. rostrata* has 76 to 90. Differences in the regression equations of gill filament length on standard length, and of head length on standard length between fish from several geographic areas are shown. Other characters examined include numbers of vertebrae, fin rays, gill rakers, and scale rows; and morphometric ratios, using lengths of eye, snout, predorsal, first dorsal fin ray, maxillary, and gill rakers, and width of interorbital.

INTRODUCTION

Fishes of the benthopelagic morid genus *Antimora* are widely distributed in the world oceans, ranging in depth between 402 and 2905 m (Grey 1956), and are very abundant in some regions (Wenner and Musick 1977). They appear to be most common on the continental slopes of subarctic, subantarctic, and temperate regions, but are generally rare in the subtropics and tropics, although they are apparently common in the vicinity of the Hawaiian and Galápagos islands.

The genus *Antimora* is distinguished from other members of the family Moridae by the combination of a pronounced pointed snout, a pelvic fin with six rays, a well-developed mental barbel, a long-based second dorsal fin with more than 50 rays, and a deep indentation in the outline of the anal fin (Svetovidov 1948). There is little information on food habits because specimens brought to the surface routinely evert their stomachs. Sedberry and Musick (1978) found only 10 specimens with intact stomachs in numerous deep-water trawlings. Individuals with ripe eggs are unknown, and specimens smaller than 100 mm are rare. Males longer than 325 mm are uncommon, although females are often longer than 600 mm. Within its depth range, there is a segregation by sex and also by size of individuals (Iwamoto 1975; Wenner and Musick 1977). Available information on the taxonomy and distribution of the genus was summarized by Iwamoto (1975).

Although this study shows that only *Antimora rostrata*, occurring in all areas except the North Pacific, and *A. microlepis*, occurring only in the North Pacific, are valid species of the genus *Antimora*, the following species and their associated localities have been previously proposed: *Haloporphyrus rostrata* Günther, 1878,

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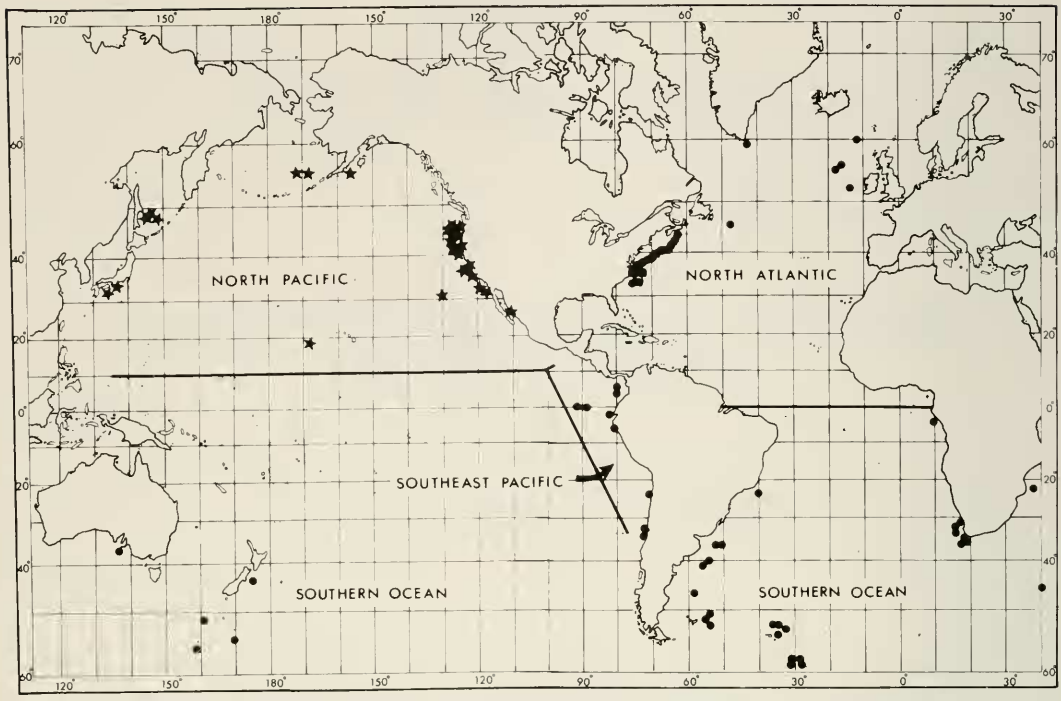

FIGURE 1. World localities from which specimens of *Antimora* spp. were studied. Stars = *A. microlepis*, dots = *A. rostrata*. Heavy black lines divide regions.

from subantarctic seas; *Haloporphyrus viola* Goode and Bean, 1878, from the temperate western North Atlantic; *Antimora microlepis* Bean, 1890, from the temperate eastern North Pacific; *Antimora rhina* Garman, 1899, from the Gulf of Panama; *Antimora australis* Barnard, 1925, from off the Cape of Good Hope; and *Antimora meadi* Pequeño, 1970, from off the coast of Chile.

No comparison has ever been made of populations represented by these six names. The closest approach was that of Schroeder (1940) who examined limited material of the first four nominal species (he apparently overlooked *A. australis*) and suggested that they be referred to the same species. The object of the present paper is to resolve the number of valid species of *Antimora* using measurements, counts, and the known species distributions.

Biological and distributional information are useful in clarifying the taxonomy of *Antimora*. It has been shown that in the western North Atlantic *Antimora* becomes larger with increasing depth but does not reproduce within the area of its greatest known abundance (Wenner and Musick 1977). Migrations may be a regular part of the life history of the western North Atlantic population. The mobility of *Antimora* has been confirmed by Cohen (1977) who has shown that these fish are able swimmers. Perhaps there is a single interbreeding North Atlantic population. If *Antimora* from other regions have the same swimming ability, then there may be single populations in the southeastern Pacific, the southern oceans, and the northern Pacific. Although data for this study were originally segregated on the basis of six geographical regions (see Materials), characters of *Antimora* in the western and eastern North Pacific were found to be similar as were those from the western and eastern North Atlantic. A preliminary analysis indicated that the four geographical groupings mentioned above provide a more appropriate basis for comparison (Fig. 1).

METHODS

Measurements and counts were made according to Hubbs and Lagler (1970) and include:

standard length, head length, snout length, predorsal length, eye diameter, upper jaw length, interorbital distance, first dorsal fin ray length, number of scales along the lateral line, and number of scale rows between lateral line and dorsal origin. Numbers of vertebrae (including the hypural plate), anal rays, and dorsal rays were read from radiographs.

Numbers of gill filaments and gill rakers on the first gill arch, lengths of the longest gill raker and gill filament (measured from base to tip, Fig. 2), length of longest gill raker at the gill angle, and dorsal fin ray length (from the anterior base to the tip of the first ray) were compared. Broken and otherwise damaged rays were not measured.

Coloration, often used in early descriptions, was not recorded due to color changes which occur in preserved specimens. However, an attempt was made to recheck other characters presented in original descriptions.

Materials

A total of 449 specimens were examined (refer to figures for length summary).

Western North Pacific (between 33°N to 48°N and 135°E to 145°E; 6 specimens): U.S. National Museum (USNM): 161494 (1); 160607 (1); 160606 (1); 149228 (1); 117886 (2).

Eastern North Pacific (between 18°N and 56°N; 96 specimens): California Academy of Sciences (CAS): 3883 (2); 37559 (1); 34354 (2); 34353 (2); 32308 (2); 27525 (1); 26226 (1); uncat. (3); CAS-SU 5276 (5); 77 (1). Museum of Comparative Zoology (MCZ): 28250 (1). Scripps Institution of Oceanography (SIO): 70-249 (22); 70-247 (2); 68-443 (1); 59-265 (1). University of Washington (UW): 19309 (2); 19235 (1); 19228 (7); 19139 (4); 18492 (8); 18201 (2) 18190 (2); 17180 (7); 19149 (1); 18493 (5). USNM: 45361 (2 syntypes of *Antimora microlepis*); 54573 (1); 54364 (1); 53876 (3); 48562 (1); 47238 (1); 47237 (1).

Western North Atlantic (between 27°N and 59°N; 117 specimens): Institut für Seefischerei, Hamburg (ISH): 79/73 (2). MCZ: 53949 (1); 38282 (3); 38073 (3); 37633 (1); 37619 (2); 37595 (1); 37520 (1); 37585 (2). University of Maine, Darling Center (UMDC): 313-1 (1); 306-2 (1). USNM: 21837–8 (2 syntypes of *Haloporphyrus viola*); uncat. (35); 31725 (1). x-ray counts only: 143250 (1); 45872 (1); 45845 (1); 45808 (1); 36163 (1); 38142 (1); 38068 (1); 38064 (3); 38019 (1); 35595 (1); 35566 (1); 33446 (4); 33443 (7); 33340 (3); 33337 (5); 33014 (1); 31768 (1); 28612 (1); 28611 (1); 28610 (1); 28609 (1); 28608 (1); 24746 (1). Virginia Institute of Marine Sciences (VIMS): 3458 (2); 3243 (1); 1471 (7); 1460 (3); 872 (4); 870 (1); uncat. (3).

Eastern North Atlantic (between 50°N and 60°N; 6 specimens): ISH: 112/74 (1); 111/74 (1); 146/74 (2); 745/74 (2).

Southeastern Pacific (between 0°S to 56°S and 70°W to 91°W; 123 specimens): USNM: uncat. (120). MCZ: 28610 (1) and 28611 (2) (3 syntypes of *Antimora rhina*).

Southern Oceans (specimens from southern Atlantic, Indian, and Pacific oceans, excluding southeastern Pacific specimens; 101 specimens): ISH: 2191/68 (2); 1250/66 (1); 1241/66 (2); 1142/66 (11); 1129/66 (1); 361/71 (2); 344/71 (1); 286/71 (1); 152/67 (8); 151/67 (3); 150/67 (1); 33/76 (5); WH32/76 (5). Los Angeles County Museum (LACM): 10033 (12); 10032 (8); 10985-5 (3); uncat. (9). University of Florida (UF-TABL): 503 (1). UMDC: uncat. station numbers 01343 (1); 01342 (1); 00198 (1); 00165 (1); 00157 (1); 00152 (1). USNM: 188827 (1 syntype of *Antimora australis*); 188829 (3); 188823 (5); 188822 (2); uncat. (3). British Museum Natural History (BMNH): 1887.12.-17.36 (holotype of *Haloporphyrus rostratus*, x-ray only).

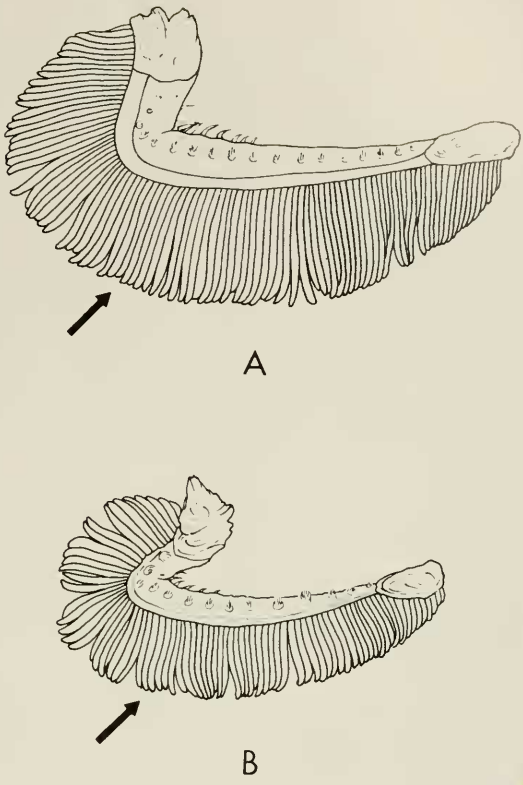

Figure 2. Medial view of first gill arch of left side to illustrate location of gill filament measurement. (*A*) *Antimora microlepis*, UW 17180, off Columbia River, 46°N, 124°W, 310 mm SL; (*B*) *Antimora rostrata*, LACM 10985-5, southwest of New Zealand, 56°19′S, 158°29′E, 330 mm SL. Drawn by Keiko Hiratsuka Moore.

Results

Antimora may be divided into two distinct species instead of the six described, based on the number of gill filaments and secondarily on the ratio of gill filament length to standard length. Other measurements can be used but with less distinct separation of species.

Counts.—North Pacific specimens possess 90–103 gill filaments on the first gill arch, compared with 76–90 in specimens from the other

TABLE 1. COMPARISON OF THE FREQUENCY OF GILL FILAMENT NUMBER BY STANDARD LENGTH GROUP FOR *Antimora microlepis* FROM NORTH PACIFIC (1), AND *Antimora rostrata* FROM THE NORTH ATLANTIC (2), SOUTHEAST PACIFIC (3), AND SOUTHERN OCEANS (4).

	Number of gill filaments																															
SL (mm)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106
100–150			3	3	2	44 4		4		23 4		22 4	23 4					1		1				1		1					
151–200			4	3		4	3	33 4	24 44	2	34				4					11			1		1	1				
201–250			3			34	4	23	34 4		2	2		3		1				11	1	11	1				1				
251–300			4	2	2	3		22 4	3	23	3		22	24		1	11	1	11	1	11 11	11	11 11	11 11	11 1	11 1					11
301–350	3			3		3	34		2	33 4	24	22	3	2	11 2				11	11 11	11 1	1		1		1		1			
351–400										23				2	3			1			11	1									
401 +						4	4													1			1		1						

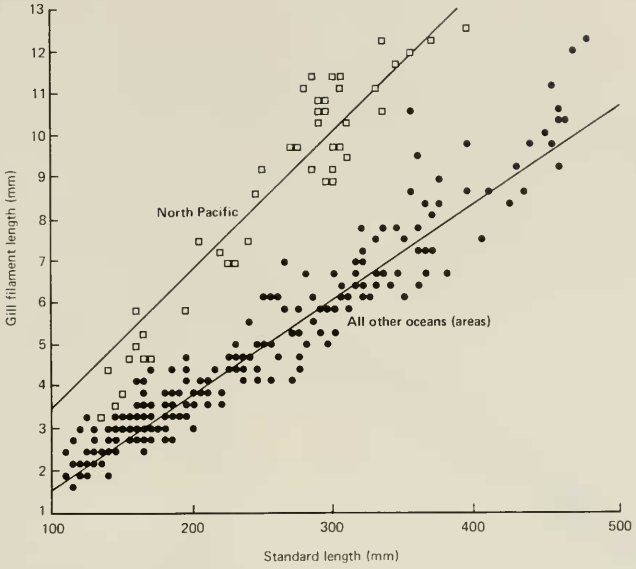

FIGURE 3. Regression of gill filament length on standard length in *Antimora* from four divisions of the world oceans: North Pacific, squares; southeast Pacific, Southern Ocean, and North Atlantic, dots. North Pacific: $y = 0.03x - 0.10$, $n = 51$. All other oceans (areas): $y = 0.02x - 0.70$, $n = 230$.

regions (Table 1). Number of gill filaments appears to be constant over the size range of specimens in all populations.

Only slight differences between samples were found from the four geographical areas in total vertebral number, number of gill rakers on the first arch, and anal and dorsal fin rays (Table 2).

Although the size and number of scales have been used in several of the species descriptions previously mentioned, they are not useful characters for the differentiation of these species. Specimens of *Antimora* are very fragile and on capture the scales and scale pockets do not remain intact for use as a reliable character.

MEASUREMENTS.—Specimens collected from the eastern and western North Pacific north of latitude 10°N have a gill filament length relatively greater than that in fish caught elsewhere. Above the size range of approximately 150 mm standard length, the length of the filaments distinctly separate North Pacific fishes from all other groups. Least square regression lines were fit

TABLE 2. SUMMARY OF SELECTED COUNTS AND LENGTH PROPORTIONS IN *Antimora* FROM THE FOUR GEOGRAPHICAL REGIONS SHOWN IN FIGURE 1 (lengths presented as ratio of standard length to size of part).

	N Pacific			SE Pacific			N Atlantic			S Ocean		
Character	$\bar{x}$	n	SD	$\bar{x}$	n	SD	$\bar{x}$	n	SD	$\bar{x}$	n	SD
Snout length	11.9	71	0.86	11.8	105	1.33	12.7	78	1.16	12.6	93	1.53
Predorsal length	3.9	69	1.47	3.7	108	0.20	3.7	76	0.17	3.9	94	0.20
Maxillary length	7.1	70	0.36	6.9	110	0.50	7.2	76	0.38	7.4	94	0.49
First dorsal fin ray length	5.9	47	1.43	7.1	94	1.58	5.1	63	1.45	6.1	54	1.40
Eye diameter	15.0	66	1.20	15.3	96	1.34	16.0	69	1.42	16.2	49	1.36
Interorbital width	17.6	38	1.45	18.6	71	1.61	15.5	32	1.56	18.3	32	1.64
Longest gill raker length	73.4	23	14.07	–	0	–	76.9	1	–	103.0	11	16.00
Total number of vertebrae	59.1	47	0.86	58.8	76	0.96	59.8	64	1.26	59.6	31	1.02
Total number of gill rakers	16.5	38	1.93	16.2	74	1.29	16.6	46	2.11	16.0	79	1.54
Total number of anal fin rays	40.6	41	1.40	39.3	56	1.39	41.9	67	1.56	40.0	28	1.70
Total number of dorsal fin rays	52.4	40	1.15	51.7	59	1.37	53.8	60	1.45	53.2	32	1.45

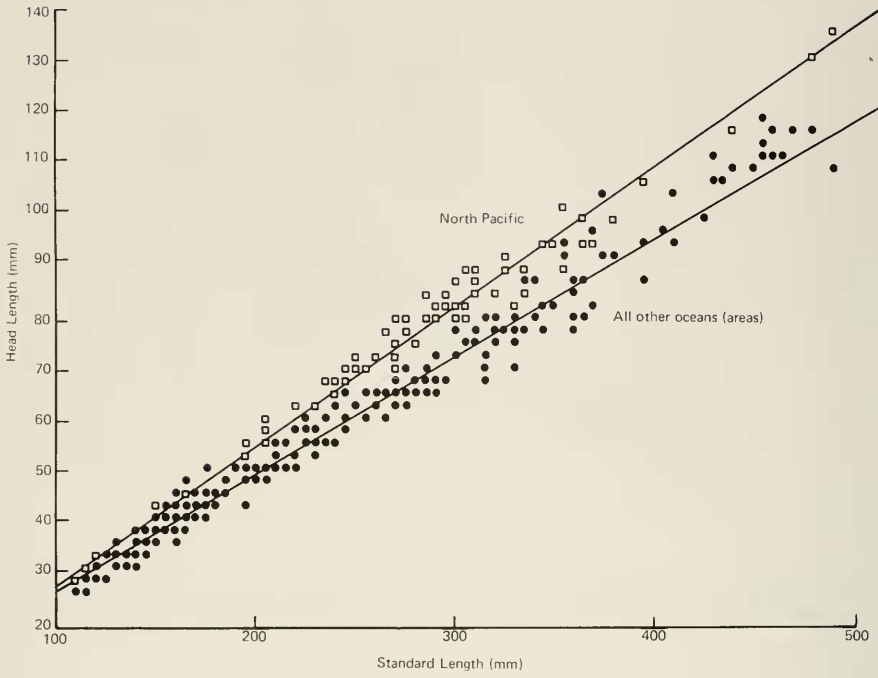

FIGURE 4. Regression of head length on standard length in *Antimora* from four divisions of the world oceans: North Pacific, squares; North Atlantic, southeast Pacific, and Southern Ocean, dots. North Pacific: $y = 0.26x + 2.22$, $n = 98$. All other oceans (areas): $y = 0.23x + 2.9432$, $n = 277$.

to the data, and the regression of gill filament length on standard length was determined following the methods of Zar (1974) (Fig. 3).

Head length against standard length (Fig. 4) also separates North Pacific specimens from all other *Antimora*. This difference is most marked in fish larger than 200 mm standard length.

Bean (1890), Garman (1899), Barnard (1925), and Pequeño (1970) noted head length to total length or standard length proportions in original descriptions with no apparent differences among the described species.

Comparisons of the length of snout, predorsal distance, maxillary, first dorsal fin ray, eye diameter, longest gill raker, and width of interorbital are summarized in Table 2. None of the measurements serve unequivocally to separate the North Pacific specimens from other *Antimora*. Fish from all other areas do show some differences: southeast Pacific, North Atlantic, and Southern Ocean populations may have slightly different lengths of first dorsal fin ray; North and southeast Pacific fish appear to have larger eyes than do other *Antimora*; and North Atlantic specimens have larger interorbital widths. Gill raker length may also show some differences, however, data for this character are incomplete.

Within the range of *A. rostrata*, there are local differences in some morphometric characters, but these differences are not consistent throughout the range of size or geography. For example, the first dorsal fin ray to standard length ratio is higher in North Atlantic specimens than those from other areas. This longer fin ray is most pronounced in specimens in the 200–400 mm range. North Atlantic fish also have a shorter snout and wider interorbital distance over certain segments of their size range as compared to specimens from other regions. Although only one specimen from low latitudes in the mid-Atlantic was examined in this study, there may be contact between North Atlantic and South Atlantic populations of *Antimora*, as specimens have been taken in the Bahamas and the Gulf of Guinea (personal communication, Daniel M.

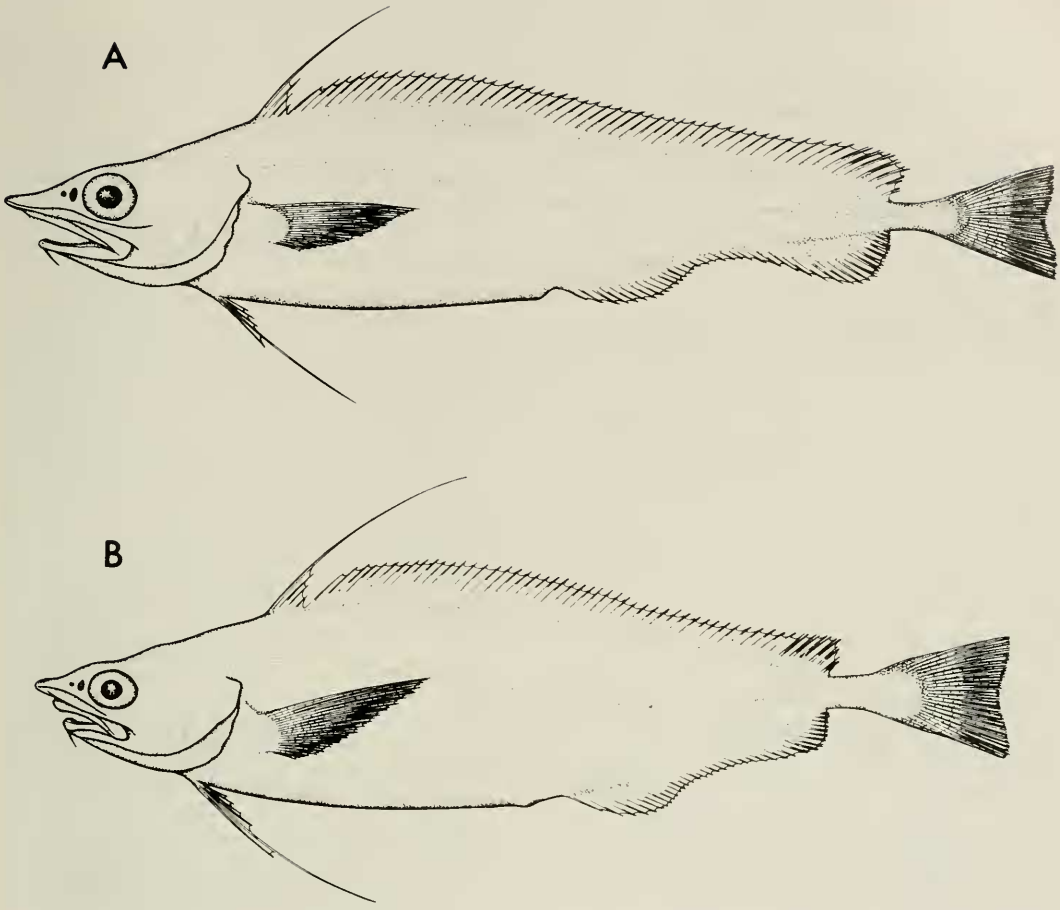

FIGURE 5. (*A*) *Antimora rostrata*, USNM 218479, SL 346 mm, male, western North Atlantic, 36°39'N, 74°28'W, 1530–1610 m; (*B*) *Antimora microlepis* CAS 32308, SL 371 mm, male, off California. Drawn by Keiko Hiratsuka Moore.

Cohen, Systematics Laboratory, National Marine Fisheries Service, NOAA, Washington, D.C.).

CONCLUSIONS

The species can be characterized as follows:

Antimora microlepis Bean, 1890

(Figure 5*B*)

Antimora microlepis BEAN, 1890:38 (type-locality: 51°23'N, 130°34'W, ALBATROSS sta. 2860, off Cape St. James, Queen Charlotte Islands, 876 fms [1602 m], 13 Aug. 1888).

CHARACTERS.—Gill filaments on first gill arch 90–103; gill filaments relatively long, regression equation of gill filament length on standard length $y = 0.03x - 0.10$; head length relatively long, regression equation of head length on standard length $y = 0.26x + 2.22$.

RANGE.—Eastern and western North Pacific Ocean, north of latitude 10°N.

Antimora rostrata (Günther, 1878)

(Figure 5*A*)

Haloporphyrus rostratus GÜNTHER, 1878:18 (type-locality: "midway between the Cape of Good Hope and Kerguelen Island; east of the mouth of the Rio de la Plata," CHALLENGER sta. 146, 1375 fms [2515 m], and sta. 320, 600 fms [1097 m]).

Haloporphyrus viola GOODE AND BEAN, 1878:257–260 (type-locality: "outer edge of Le Have Bank, at a depth of four or five hundred fathoms" [approximately 43°N, 64°W]).

Antimora rhina GARMAN, 1899:185–186 (type-locality: Gulf of Panama, ALBATROSS sta. 3353, 7°06'15"N, 80°34'W, 695 fms [1271 m], sta. 3393, 7°15'N, 79°36'W, 1020 fms [1865 m]).

Antimora australis Barnard, 1925:499 (type-locality: "off Cape Point, 475–900 fathoms" [869–1646 m]).

Antimora meadi Pequeño, 1970:14–16 (type-locality: Anton Bruun cruise 13, between 34°06′S, 72°26′W, and 34°12′S, 72°25′W, in 1400–1475 m, 3 Feb. 1966).

Characters.—Gill filaments on first gill arch 76–90; gill filaments relatively short, regression equation of gill filament length on standard length $y = 0.02x - 0.70$; head length relatively short, regression equation of head length on standard length $y = 0.23x + 2.9432$.

Range.—All oceans except the North Pacific north of 10°N.

Acknowledgments

I am thankful for the advice and support given me by Daniel M. Cohen of the Systematics Laboratory, National Marine Fisheries Service (NMFS), for initially suggesting this study, and his valuable guidance throughout the course of this work. Tomio Iwamoto (CAS) recommended that I examine gill filament length, arranged for the loan of specimens from the California Academy of Sciences, and reviewed the manuscript. Bruce B. Collette (Systematists Laboratory, NMFS) and Hugh H. DeWitt (University of Maine, Orono) also reviewed the manuscript and made valuable comments.

Special thanks are due Charles A. Wenner and John A. Musick for allowing me to read their then-unpublished manuscript on the life history of North Atlantic *Antimora* and examine specimens in their collection at the Virginia Institute of Marine Science. The Allan Hancock Foundation and Los Angeles County Museum provided Antarctic material, William Fink (MCZ) provided important materials from the North Atlantic as did Alfred Post (ISH). Richard Rosenblatt (SIO), Arthur Welander (UW), Carter Gilbert (UF), Jean Dunn (NMFS, Seattle Laboratory), and the National Museum of Natural History were all instrumental in providing additional materials. Keiko H. Moore prepared the illustrations and figures.

Literature Cited

Barnard, K. H. 1925. Descriptions of new species of marine fishes from South Africa. Ann. Mag. Nat. Hist. ser. 9, 15:498–504.

Bean, T. H. 1890. Scientific results of explorations by the U.S. Fish Commission Steamer Albatross. No. XI—New fishes collected off the coast of Alaska and adjacent region southward. Proc. U.S. Natl. Mus. 13:37–45.

Cohen, D. M. 1977. Swimming performance of the gadoid fish *Antimora rostrata* at 2400 meters. Deep-Sea Res. 24:275–277.

Garman, S. 1899. Reports on an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos Islands, in charge of Alexander Agassiz, by the U.S. Fish Commission Steamer "Albatross" during 1891, Lieut-Commander Z. L. Tanner, U.S.N. Commanding. Part 26, The Fishes. Mem. Mus. Comp. Zool. Harvard 24:1–431.

Goode, G. B., and T. H. Bean. 1878. Descriptions of two gadoid fishes, *Phycis chesteri* and *Haloporphyrus viola* from the deep-sea fauna of the northwestern Atlantic. Proc. U.S. Natl. Mus. 1:256–260.

Grey, M. 1956. The distribution of fishes found below a depth of 2000 meters. Fieldiana Zool. 36:74–336.

Günther, A. 1878. Preliminary notices of deep sea fishes collected during the voyage of H.M.S. Challenger. Ann. Mag. Nat. Hist. ser. 5, 2:17–28.

Hubbs, C. L., and K. F. Lagler. 1970. Fishes of the Great Lakes region. 4th ed. Ann Arbor: Univ. Michigan Press. 213 pp.

Iwamoto, T. 1975. The abyssal fish *Antimora rostrata* (Günther). Comp. Biochem. Physiol. 52B:7–11.

Pequeño-R., G. 1970. *Antimora meadi* n.sp. en Chile. Not. Men. Mus. Nac. Hist. Nat. (Santiago) 15:14–16.

Schroeder, W. C. 1940. Some deep sea fishes from the North Atlantic. Copeia 1940:231–238.

Sedberry, G. R., and J. A. Musick. 1978. Feeding strategies of some demersal fishes of the continental slope and rise off the Mid-Atlantic coast of the USA. Mar. Biol. (N.Y.) 44:357–375.

Svetovidov, A. N. 1948. Treskoobraznye. Faune SSSR, Ryby 9(4), 221 pp. Akad. Nauk SSSR. (Transl. from Russian: 1962, Gadiformes, Fauna USSR, Fishes. 304 pp. U.S. Dep. Comm., Natl. Tech. Inf. Serv., Springfield, Virginia; OTS 63-11071.)

Wenner, C. A., and J. A. Musick. 1977. Biology of the morid fish, *Antimora rostrata*, in the western North Atlantic. J. Fish. Res. Bd. Canada 34:2362–2368.

Zar, J. H. 1974. Biostatistical analysis. Englewood Cliffs, New Jersey: Prentice Hall Inc. 620 pp.

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